BOSE®
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OC-1 AWCS-II Option Card

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Service Manual

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CAUTION: THE OC-1 OPTION CARD CONTAINS NO USER SERVICEABLE PARTS. TO PREVENT WARRANTY INFRACTIONS, REFER SERVICING TO WARRANTY SERVICE STATIONS OR FACTORY SERVICE.

PROPRIETARY INFORMATION

THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION OF BOSE® CORPORATION WHICH IS BEING FURNISHED ONLY FOR THE PURPOSE OF SERVICING THE IDENTIFIED BOSE PRODUCT BY AN AUTHORIZED BOSE SERVICE CENTER OR OWNER OF THE BOSE PRODUCT, AND SHALL NOT BE REPRODUCED OR USED FOR ANY OTHER PURPOSE.

OC-1 SPECIFICATIONS

Dimensions:	.63" Hx1.29"Wx8.98"D(1.6x3.3x22.8 cm)
Weight:	.09 lbs. (.042 kg.)
Input/Output:	2 audio inputs,Channel 1 and 2 high frequency outputs, bass channnel output
Input Impedance: (feedback input)	482 kΩ (nominal)
Output Level:	5.0 Vrms into 10 kΩ
Crossover Frequency:	125 Hz,Roll-off slope: 24 dB/oct.
Output Noise:	≤ 40μV (A-weighted)
Channel Separation:	50 dB (min.) @ 5 kHz

THEORY OF OPERATION

Overview

The OC-1 is a small plug-in module for use with Bose 502™, 402™, and 802® II controllers. The OC-1 allows the use of the Cannon™ bass loudspeaker with these controllers and their loudspeakers. Refer to the block diagram, equalization curves and OC-1 schematic for further information.

The OC-1 provides three major functions:

A. Low frequency equalization.

B. Crossover filtering of the high frequency signals.

C. Protection of the Cannon against excessive power.

1. Low Frequency Equalization Circuit

U5's four op-amp stages provide low-pass crossover filtering, high-pass filtering to eliminate subsonic material, and frequency contouring to optimize the overall response.

2. High Frequency Equalization Circuit

U3, section 1 and U5, section 2 provide two channels of high-pass filtering to remove bass from the main loudspeakers.

3. Protection Circuit

The protection circuit consists of a compressor and a mute circuit. The protection circuit is connected so that it can monitor the low frequency voltage applied to the Cannon driver. When this voltage exceeds the power limit defined for the driver, a compressor begins to reduce the gain in the low frequency path so that the power does not continue to rise.

4. Compressor Circuit

The compressor consists of the following functional blocks:

A. Differential input buffer
B. Full-wave peak detector/comparator
C. Averaging circuit
D. Voltage-controlled amplifier (VCA)

The differential input buffer (**U1 section 1**) features protection against Radio Frequency Interference (RFI), Electrostatic Discharge (ESD), and overvoltage. It has a gain which is much less than 1 so that it can attenuate the high level signals coming from the Cannon (over 40 volts at full power).

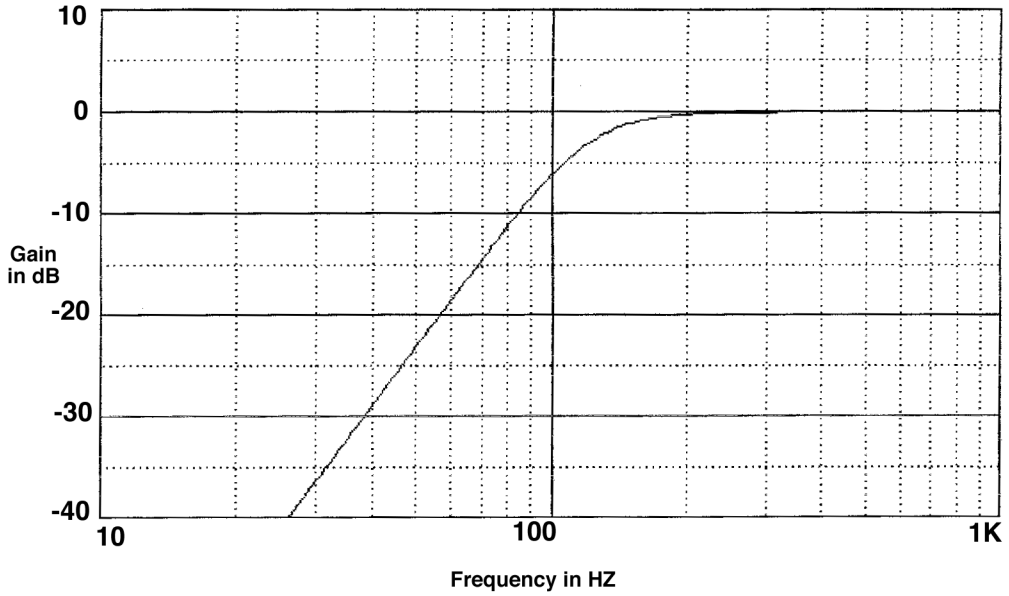
U4, sections 1 and 2 form a full-wave peak detector. When the input to these stages exceeds +/-2V peak, the outputs go high and a control voltage is created in the averaging circuit **(C27, C28,** etc.). The averaging circuit captures peaks with a short attack time and holds them with a longer release time. **U2, section 2** inverts and scales the averaged control voltage and applies it to the VCA control input.

U7 is a current-in/current-out VCA which is controlled by the voltage on **pin 2**.

5. Mute Circuit

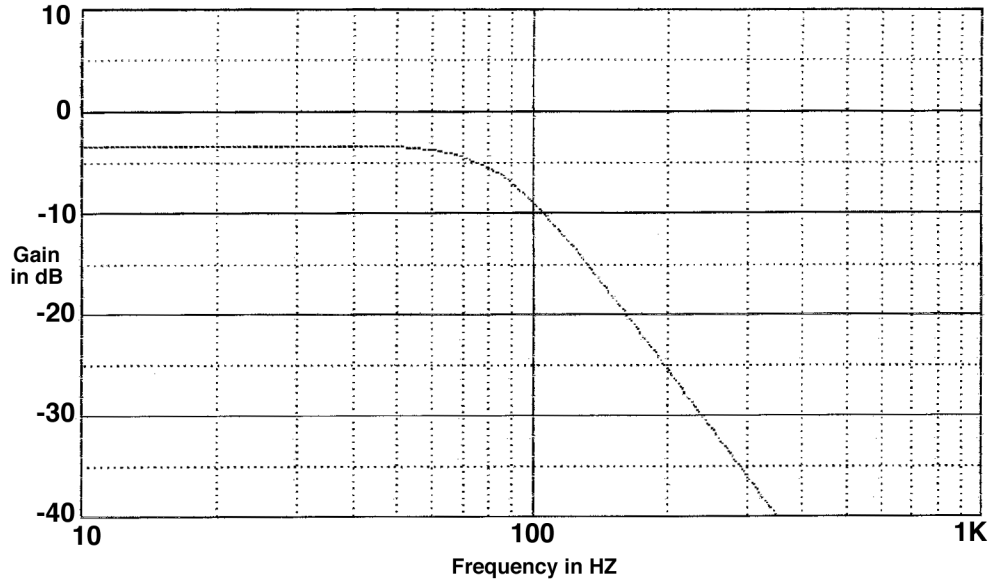
The mute circuit acts as a watchdog, and prevents the Cannon™ from operating unless the feedback signal from the Cannon is connected properly to the controller/OC-1 protection input. When the mute circuit detects that no audio has occurred for about two minutes, it reduces the gain in the low frequency path.

The mute circuit consists of a gain stage and a comparator. **U1, section 2** amplifies the signal from the protection circuit differential input, and **U2, section 1** compares it to a reference. When the sensed level exceeds the threshold, a control voltage (generated in **U2, section 2)** causes **U2, section 1** to go from high to low and reduces the compressor gain by about **40 dB.**



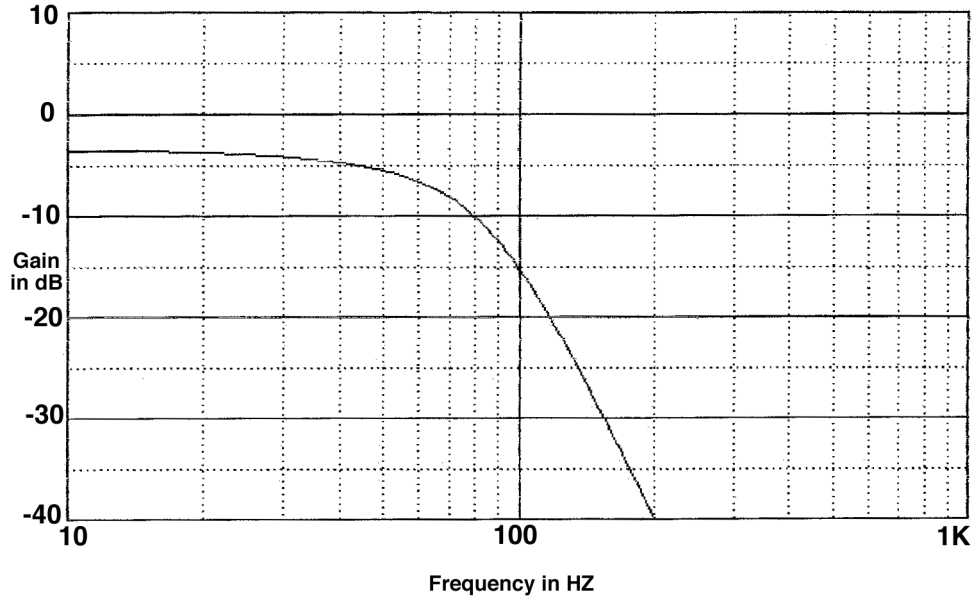
Output is measured from U3 pin 7 or U6 pin 1. Controls are set at:: Mode 4 (Option), Output Mode: Normal, Low Frequency Level: 0 dB, and Input Level: +4 dB.

Figure 1. High Frequency EQ



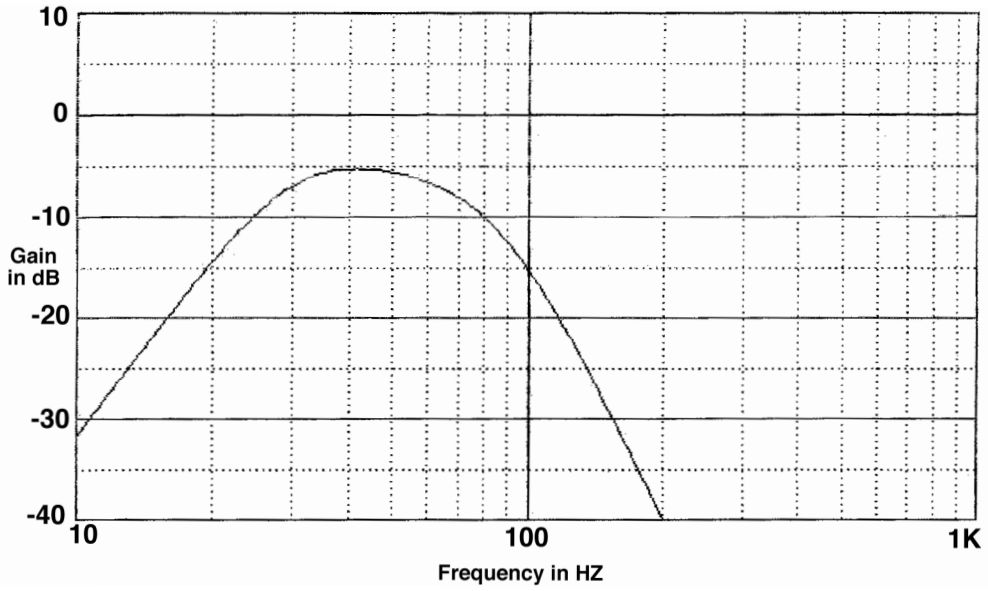
Output is measured from U5 pin 14. Controls are set as in Figure 1.

Figure 2. EQA + EQB



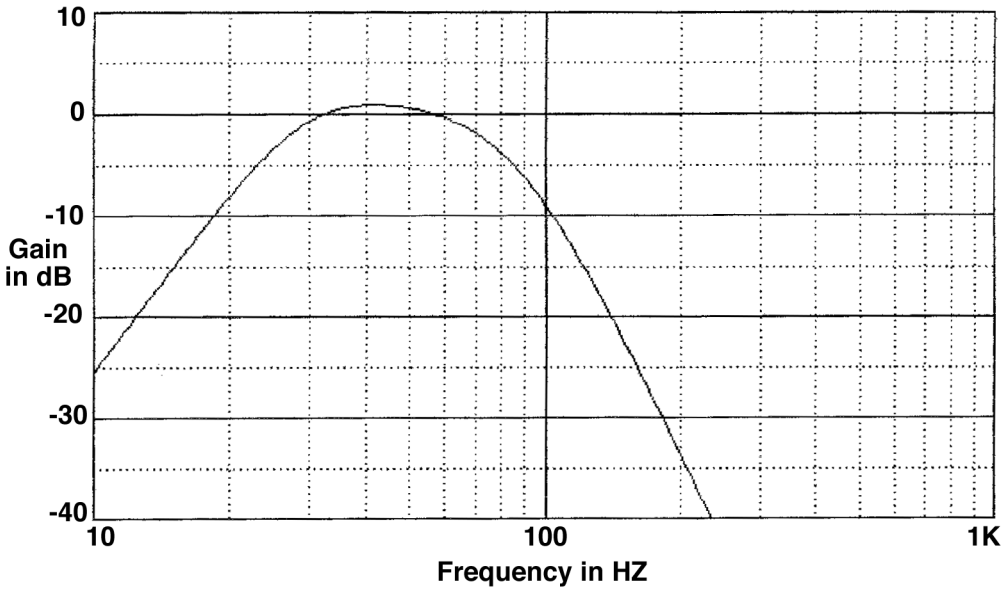
Output is measured from U5 pin 1. Controls are set as in Figure 1.

Figure 3. EQA + EQB + EQC



Output is measured from U5 pin 7. Controls are set as in Figure 1.

Figure 4. EQA + EQB + EQC + EQD



Output is measured from U3 pin 1. Controls are set as in Figure 1.

Figure 5. EQA + EQB + EQC + EQD + VCA

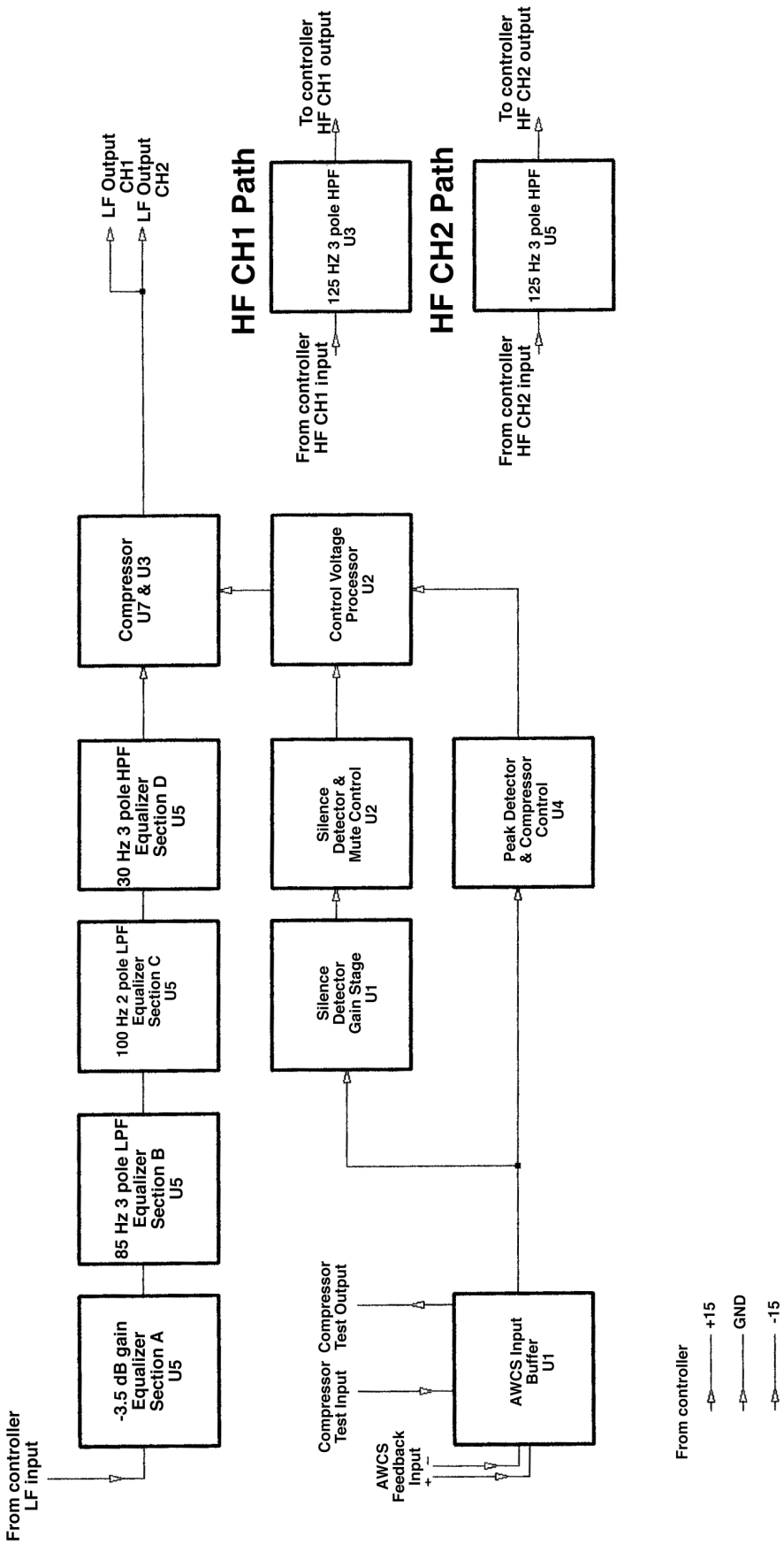

LF Path
From controller LF input
-3.5 dB gain Equalizer Section A U5
85 Hz 3 pole LPF Equalizer Section B U5
100 Hz 2 pole LPF Equalizer Section C U5
30 Hz 3 pole HPF Equalizer Section D U5
Compressor U7 & U3
LF Output CH1
LF Output CH2
Compressor Test Input
Compressor Test Output
AWCS Feedback Input
AWCS Input Buffer U1
Silence Detector Gain Stage U1
Silence Detector & Mute Control U2
Control Voltage Processor U2
Peak Detector & Compressor Control U4
HF CH1 Path
From controller HF CH1 input
125 HZ 3 pole HPF U3
To controller HF CH1 output
HF CH2 Path
From controller HF CH2 input
125 Hz 3 pole HPF U5
To controller HF CH2 output
From controller
+15
GND
-15

Figure 6. OC-1 Block Diagram

OC-1 Installation Procedures

NOTE: The information included here is to aid the technician in setting up the OC-1 before doing any troubleshooting. These procedures are provided in more depth in the OC-1 Owner's Guide (P/N 176007).

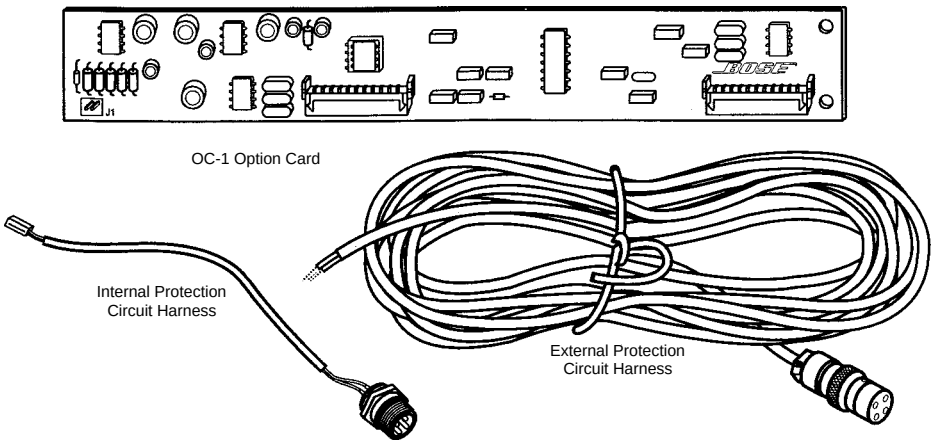


Figure 7. OC-1 Option Card and Harnesses

1. Installing the Internal Protection Circuit Harness

A. Turn the controller so that its rear panel faces you. See **Figure 8.**

B. Remove 4 phillips-head screws.

C. Slide the cover towards you and lift away from the controller.

D. Find the plastic plug in the controller's rear panel **(Figure 9).** Pinch the top lock tab and push the plug partially out **(Figure 9A).** Release the tab and pull the plug completely out.

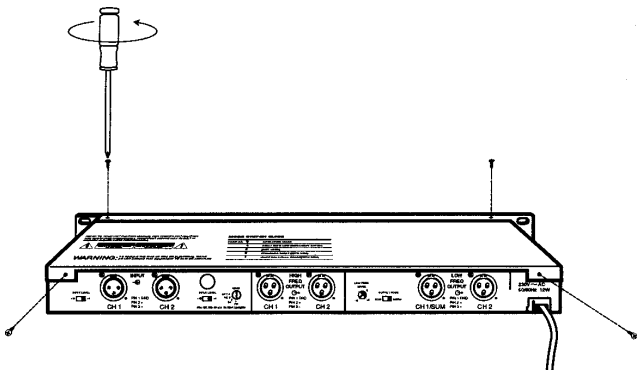


Figure 8. Cover and screw removal

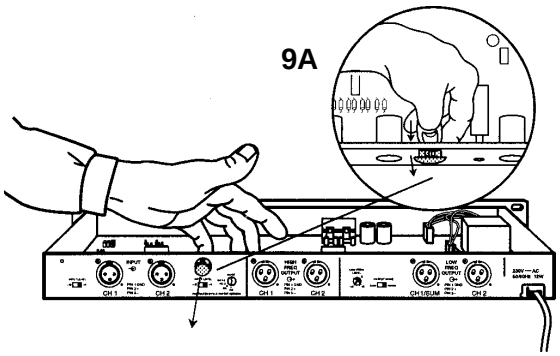


Figure 9. Plastic plug removal

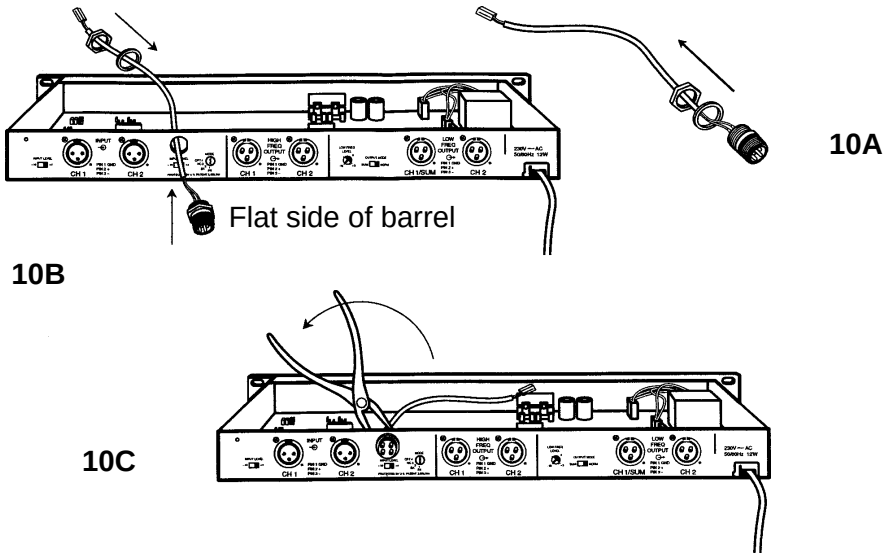


Figure 10. Internal Harness Connection

E. Remove the lock nut and washer from the harness **(Figure 10A).**

F. Thread the harness through the rear panel (white connector first).

G. Turn the barrel connector so that its flat side matches the flat side of the hole in the controller. The connector should sit firmly against the outside of the rear panel **(Figure 10B).**

H. Replace the lock nut and washer on the harness inside the rear panel. Tighten firmly with needle nose pliers **(Figure 10C).**

2. Connecting the OC-1 to the controller

NOTE: The controller's rear panel should face you and the internal harness should be inside.

A. Turn the OC-1 PCB so that its component side faces you.

B. Connect the harness to **J1** on the OC-1 PCB **(Figure 11).**

C. Plug the PCB into the connector receptacles located on the controller's PCB. See **Figure 12** for proper orientation.

3. Installing the External Protection Circuit Harness

A. Attach the external harness to the internal harness connector **(Figure 13)** by turning the notch on the harness to the right.

B. Hand tighten the lock nut on the external harness.

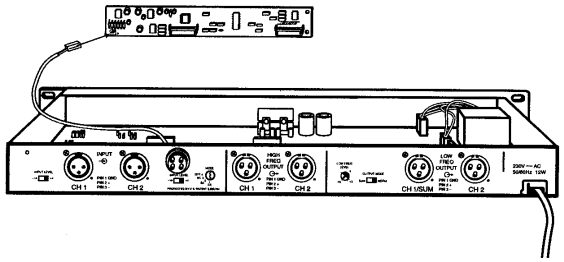


Figure 11. System Controller Connection

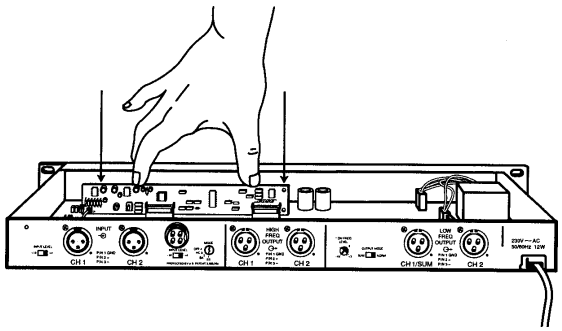


Figure 12. OC-1 connected to controller PCB

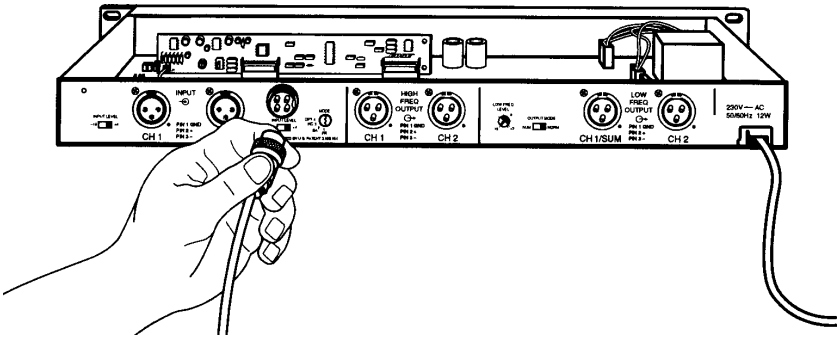


Figure 13. External Harness Connection

C. Connect the harness's other end to the speaker terminals on your amplifier with either screw lugs **(Figure 14A)** or a banana plug **(Figure 14B).** Connect the red wire to the positive (+) terminal and the black wire to the negative (-) terminal.

NOTE: Figure 15 shows a typical system hookup.

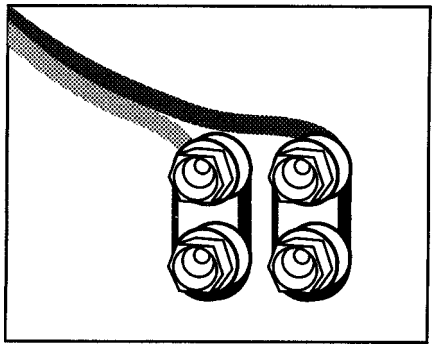


Figure 14A. Screw terminal

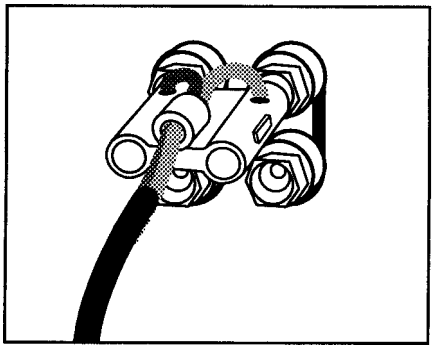


Figure 14B. Banana plug

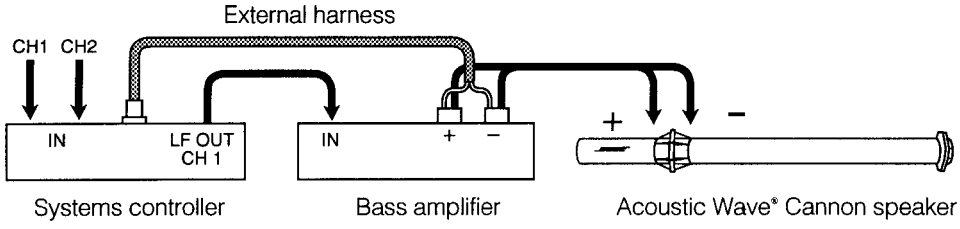


Figure 15. Complete system hookup

OC-1 Test Procedures

Test Setup

Input Connections: Connect an oscillator to the positive (+) and negative (-) input terminals for **Channels 1 or 2**. These procedures assume that the person performing these tests is using test equipment with unbalanced inputs and outputs. See **Figure 16** for connection information. Also, refer to **Figure 15** for a system hookup diagram.

Output Connections: Connect test equipment to the positive (+) and negative (-) output terminals for **Channels 1 or 2** (low and high frequency outputs).

All tests should be performed for both channels.

All test equipment must be isolated from ground (floated).

See **Figure 17** for a picture of the controller's back panel.

The controls on the back panel should be set as follows:

- Mode switch should be set at **4 (Option)**
- Output mode switch should be set at **normal**
- Input switches should be set at **+4 dB**
- Low frequency level potentiometer should be set at **0 dB**

****IMPORTANT NOTE****

Install the external protection circuit harness for all tests. Otherwise, the controller's bass channel (as a safety measure) will shut down.

1. Frequency Response of High Frequency (HF) Output

A. Apply a **100 mVrms, 600 Hz** signal to the controllers's input terminals and reference your dB meter to this frequency.

B. Measure the frequency response across the **HF outputs** according to the chart below. This chart provides responses for the 402, 502, and 802 II controllers (with the option card installed).

Frequency (Hz)	402™ Controller Response (dB)	502™ Controller Response (dB)	802® II Controller Response (dB)
40	-29.2 ± 1.5 dB	-23.5 ± 1.5 dB	-17.57 ± 1.5 dB
80	-8.3 ± 1.5 dB	- 5.6 ± 1.5 dB	-1.84 ± 1.5 dB
100	-3.0 ± 1.5 dB	+0.8 ± 1 .5 dB	+2.0 ± 1.5 dB
120	0 dB	+1.6 ± 1 .5 dB	+4.0 ± 1.5 dB
150	+1.83 ± 1.5 dB	+1.93 ± 1.5 dB	+4.7 ± 1.5 dB
180	+2.16 ± 1.5 dB	+0.7 ± 1.5 dB	+4.2 ± 1.5 dB
200	+2.11 ± 1.5 dB	+.15 ± 1.5 dB	+3.7 ± 1.5 dB
600	REF	REF	REF
2200	+2.12 ± 1.5 dB	+3.5 ± 1.5 dB	+1.61 ± 1.5 dB
5000	+7.5 ± 1.5 dB	+12.5 ± 1.5 dB	+7.29 ± 1.5 dB
15000	+12.85 ± 1.5 dB	+19.0 ± 1.5 dB	+17.02 ± 1.5 dB

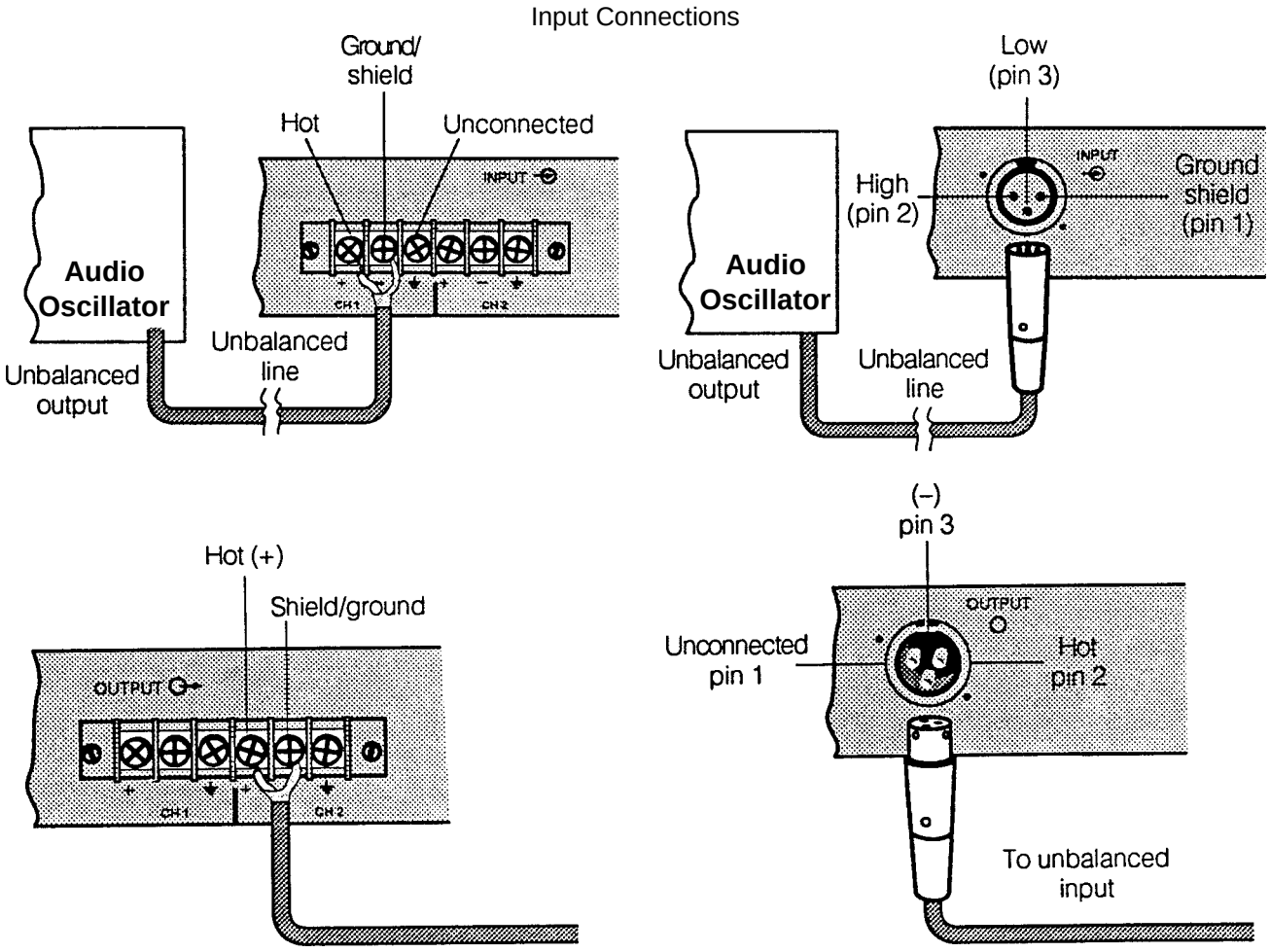


Figure 16. Unbalanced Connections

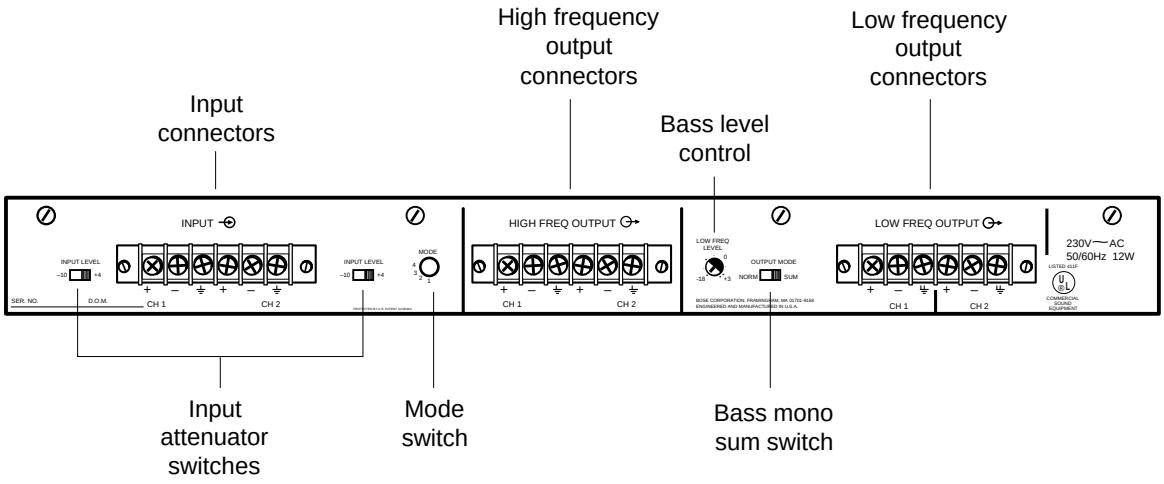


Figure 17. Typical Controller Back Panel (Barrier Strip Version Shown)

2. Frequency Response of LF Output

A. **Apply a 100 mVrms, 80 Hz** signal to the controller's input terminals and reference your dB meter to this frequency.

B. Measure the frequency response across the **LF outputs** according to the chart below.

Frequency (Hz)	**Response (dB)**
20	-10.5 ± 1.5
50	+2.25 ± 1.5
80	REF
100	-7.35 ± 1.5
120	-13.68 ± 1.5
150	-21 ± 1.5
180	-27 ± 1.5
200	-30.5 ± 1.5

3. Protection Circuit Test

NOTE: Refer to **Figures 13 through 15** and the installation instructions for connecting the external protection circuit harness.

A. Connect a signal generator to the controller input terminals.

B. Connect the controller LF outputs to the amplifier input terminals.

C. Connect the external protection circuit harness to the amplifier output.

D. Connect a voltmeter across the amplifier output terminals.

E. Apply a **57 Hz** signal to the controller input terminals and adjust the signal generator until the amplifier's output voltage is **40 Vrms.**

F. Increase the input to the amplifier until the output voltage is **47 Vrms.** Continue increasing the input to the amplifier. The amplifier's output voltage should not rise above **47 volts** (compression occurs at this voltage).

Notes for Future Reference

OC-1 Option Card Parts List

OC-1 Packaging Parts List (Figure 16)

Item Number	Description	Part Number	Qty. Per Carton	See Note
1	Cable Assembly	174147	1	1
2	Option Card PCB Assembly	145610	1	2,3
-	Bag-Antistatic	174138	1	4
-	Card-Owner's Registration	122157	1	4
-	Envelope	122785	1	4
-	Owner's Manual	176007	1	4
-	Carton	145618	N/A	4

NOTES

1. The cable assembly consists of both the internal and external protection circuit harnesses.

2. This part is not normally available from Customer Service. Approval from the field service manager is required before ordering.

3. The individual parts located on this PCB are listed in the Electrical Parts List.

4. This part is not illustrated.

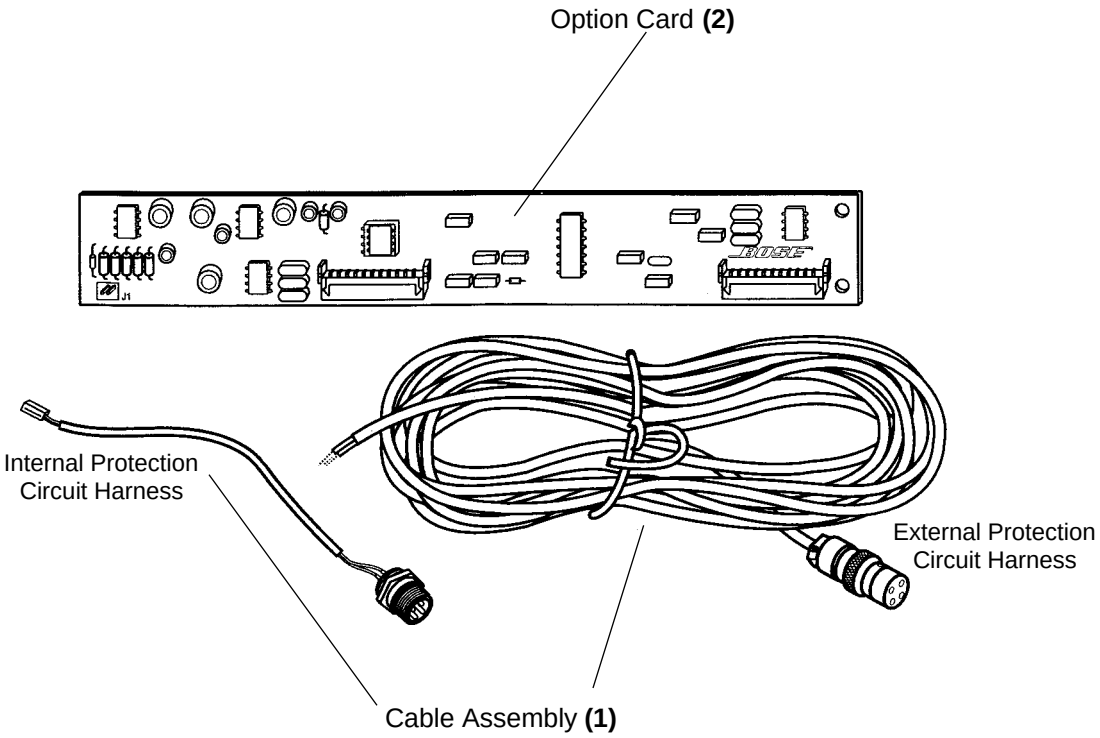


Figure 16. Option Card and Cable Assembly

OC-1 Electrical Parts List

Resistors

Reference Designator	Description	Part Number	See Note
R1-4	475 KΩ,1%,1/4W, 52mm,MF	121245-2214753	
R6,7,41,75,76	7.5 kΩ,1%, 1/10W,0805	133625-7501	
R8,39	100 Ω,1%, 1/10W,0805	133625-1000	
R9,10,12,14	200 kΩ,5%, 1/10W,0805	133626-2045	
R11,17	1 MΩ,5%,1/10W, 0805	133626-1055	
R13,90,93	10 kΩ,1%, 1/10W,0805	133625-1002	
R15	51 Ω,5%,1/10W, 0805	133626-5105	
R16	4.64 kΩ,1%, 1/10W,0805	133625-4641	
R18	12.4 kΩ,1%, 1/10W,0805	133625-1242	
R19,25,28	20 kΩ,1%,1/10W, 0805	133625-2002	
R22	41.2 kΩ,1%, 1/10W,0805	133625-4122	
R24	5.1 kΩ,5%,1/10W, 0805	133626-5125	
R26,29	7.87 kΩ,1%, 1/10W,0805	133625-7871	
R27,30	137 kΩ,1%, 1/10W,0805	133626-1373	
R32,37	17.4 kΩ,1%, 1/10W,0805	133625-1742	
R33,36	100 kΩ,1%, 1/10W,0805	133625-1003	
R34	2.43 kΩ,1%, 1/10W,0805	133625-2431	
R35	2.94 kΩ,1%, 1/10W,0805	133625-2941	
R38	301 Ω,1%, 1/10W,0805	133625-3010	
R45	750 Ω,1%, 1/10W,0805	133625-7500	
R48	1.54 kΩ,1%, 1/10W,0805	133625-1541	
R50	35.7 kΩ,1%, 1/10W,0805	133625-3572	

Resistors (Continued)

Reference Designator	Description	Part Number	See Note
R52,58,64,65,69, 77,78,83,89,94	Jumper-Chip,0805	133627	
R54,62,63	14 kΩ,1%, 1/10W,0805	133625-1402	
R85	26.1 kΩ,1%, 1/10W,0805	133625-2612	
R88	178 kΩ,1%, 1/10W,0805	133625-1783	
R92	1.4 kΩ,1%,1/10W, 0805	133625-1401	
R95	255 kΩ,1%,1/10W, 0805	133625-2553	

Diodes

Reference Designator	Description	Part Number	See Note
D1,4	Zener,5%,18V,1W 1N4746	116995-4746A	
D2,3,9	Dual,SOT-23	147239	
D5,6	1N4148,75V, 300mA,Switching **or**	121501 116997	
D7,8	Dual,SOT-23	147249	

Integrated Circuits

Reference Designator	Description	Part Number	See Note
U1-4,6	Op Amp,RC4559, Dual	108568	
U5	Op Amp-NJM2059,Quad	144008	
U7	VCA, 18V, SIP-8, 2155	175120	

Connectors

Reference Designator	Description	Part Number	See Note
J1	Header,2 pos, Male	134739-02	
J4,5	Header,Rtang, 12 pos.	149358	

Reference Designator	Description	Part Number	See Note
C1,2,57	3300 pF,10%,50V, X7R,0805	133623-332	
C3	100 µF,20%,25V, 105,Electrolytic	120767	
C4,7,13,27,28	10 µF,20%,16V, 105,Electrolytic	137126-100	
C5,6,8,9,18,19, 23-26,38,39,59	.022 µF,10%, 50V, X7R,0805	133623-223	
C10	22 µF,20%,25V, BP,EL	147522-220	
C11	1 µF,20%,50V, 105,Electrolytic	137126-1R0	
C14	100 pF,5%, 50V, Cog,0805	133622-101	
C15-17,20-22	.047 µF,5%, 63V, 85,Box	137127-473	
C35	.18 µF,5%, 50V, 85,Box	137127-184	
C42	.027 µF,5%, 63V, 85,Box	137127-273	
C43	.47 µF,5%, 50V, 85,Box	137127-474	
C48,51	.22 µF,5%, 50V, 85,Box	137127-224	
C52,54,55	.15 µF,5%, 50V, 85,Box	137127-154	

SPECIFICATIONS AND FEATURES SUBJECT TO CHANGE WITHOUT NOTICE

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